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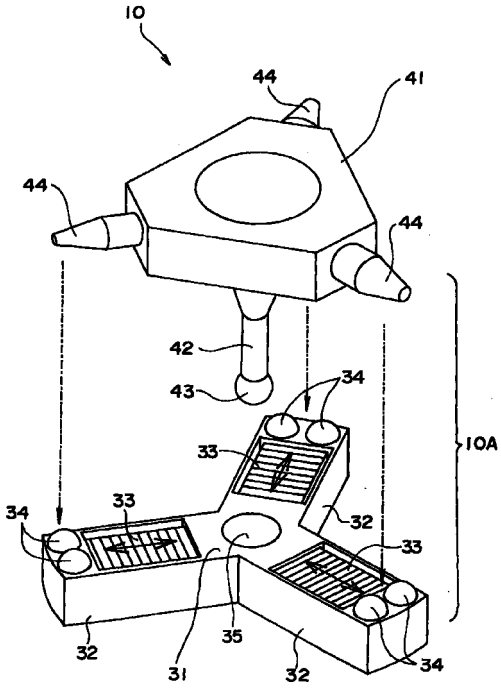
(54) Reseat system of a touch signal probe with a contact point double displacer

(57) A reseat system of a touch signal probe includes a fixed component (31), a movable component (41), a pair of hard ball (34) provided on the fixed component (41), a cylindrical body (44) provided on the movable component (41) for abutting the hard ball (34), and a piezoelectric element (33) for relatively sliding the hard ball (34) and the cylindrical body (44). Since an outer circumference of the cylindrical body (4) has conic shape, both a contact point on the cylindrical body (44) and a contact point on the hard ball (34) change position thereof during relative slide movement.

FIG.1



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Description

[0001] The present invention relates to a reseat system of a touch signal probe installed in a coordinates measuring machine. More specifically, it relates to a reseat system of a touch signal probe having a fixed component and a movable component, the reseat system allowing displacement of the movable component relative to the fixed component when a force is applied to the movable component from the outside and accurately returning the movable component to a rest position when the force applied to the movable component ceases to exist.

[0002] A touch signal probe is used in a coordinates measuring machine for detecting contact. In the coordinates measuring machine having the touch signal probe, a probe movable in three-dimensional directions touches a workpiece on a fixed table and a coordinate value of respective axes (respective axes in the three-dimensional directions) when the probe touches the workpiece is read as an electric trigger, so that dimension and configuration of the workpiece is measured based on the coordinate value. Accordingly, a position of the probe can be detected by an electric touch signal based on contact between the probe and the workpiece.

[0003] Fig. 5 shows a conventional touch signal probe. In the figure, a stylus 1 is fixed to a movable component 2. A contact ball 4 is provided at a distal end of the stylus 1. Three cylindrical bodies 3 radially projects with 120 degrees interval around an axis of the stylus 1 from a periphery of the movable component 2 on a plane perpendicular to the axis of the stylus 1. On the other hand, the fixed component 5 has three pairs of cylindrical body 6 on a position corresponding to cylindrical bodies 3 of the movable component 2. The cylindrical body 3 and the cylindrical body 6 constitute a reseat component for defining relative position of the fixed component 5 and the movable component 2 at one place.

[0004] According to the above arrangement, the movable component 2 is pressed to the fixed component 5 by virtue of a biasing force F of a biasing component (not shown) and the movable component 2 is forcibly brought into contact with the fixed component 5 through the reseat component. When pressing force from the workpiece is not applied to the distal end of the stylus 1, the movable component 2 rests on the fixed component at six contact points. In other words, respective cylindrical bodies 3 of the movable component 2 rest on the respective cylindrical body 6 at two points, total six points. Accordingly, the reseat system is called as a six-point contact reseat system.

[0005] According to the six-point contact reseat system, reseat position of the movable component after an escape movement can be located at one place. In other words, assuming that the stylus 1 displaces parallel to axial direction at the rest position of the stylus 1 while maintaining contact between the reseat component on the movable component side and the reseat component on the fixed component side toward respective contact points, respective loci drawn by the distal end of the stylus crosses the axis of the stylus at the rest position. According to the arrangement, the stylus 1 returns to a unique rest position only by restoring contact with the respective contact points by the biasing force F during return movement after escape movement of the movable component 2 by the pressing force from the workpiece, so that the rest position of the stylus 2 can be kept constant.

[0006] Since the position of the movable component relative to the fixed component can be set unique by the six-point contact reseat system, the six-point contact reseat system has high anti-vibration rigidity. Further, irrespective of the direction of the outside pressing force, the six-point contact reseat system has high reseat ability in a relatively rough unit of, for instance, 10. m.

[0007] However, the above-described six-point contact reseat system causes an error ("reseat shift error") in a further fine unit of, for instance, 1. m observed in return movement after contact, the error being caused because the movable component is pushed by the workpiece during escape movement of the movable component to cause displacement relative to the fixed component.

[0008] Specifically, as shown in Fig. 6(A), when the contact ball 4 touches the workpiece W in the conventional reseat system, the stylus 1 moves in left direction in the figure as shown in Fig. 6(B). At this time, little reaction force is caused between the movable component 2 and the fixed component 5, so that the movable component 2 slightly slides in the left direction in the figure. When the workpiece W and the stylus 1 connected to the movable component 2 is no more in contact with each other as shown in Fig. 6(C), the movable component 2 conducts the return movement by virtue of the biasing force F, where the axial position of the movable component 2 is shifted on account of the aforesaid slide movement. The shift directly affects on measurement accuracy of the probe.

[0009] The Applicant of the present invention has proposed a reseat system capable of correcting reseat position shift after return movement shown in Fig. 7 (European Patent Publication No. 0764827 A2), where the reseat error is corrected by a piezoelectric element for administrating the direction of the friction force applied to a contact points between the movable component and the fixed component of the reseat system.

[0010] The reseat system has a fixed component 11, a movable component 21 and a biasing force generator (not shown) capable of allowing displacement of the movable component 21 relative to the fixed component 11 when a force is applied to the movable component from the outside and capable of returning the movable component 21 to a rest position when the force is not applied to the movable component 21.

[0011] The movable component 21 has a stylus 22 having a contact ball 24 to be in contact with the workpiece projecting therefrom and three cylindrical bodies 23 extending radially around the axis of the stylus 22 at 120 degrees interval to be in contact with the fixed component 11.

[0012] A central portion of the fixed component 11 is secured to a housing of the probe (not shown), the fixed component 11 having three arms 12 extending radially around the axis of the stylus 22 at 120 degrees interval. A pair of hard ball 13 are disposed on an upper surface of an end of the respective arms 12.

[0013] Further, a piezoelectric element 14 as a displacement generator is provided to an inner portion relative to the hard balls 13 of the respective arms 12, the piezoelectric elements being stretchable radially approximately along the axis of the stylus 22.

[0014] When a voltage is applied to the respective piezoelectric elements 14, the respective piezoelectric elements 14 synchronously displaces, so that the respective hard balls 13 displace in approximately radial direction around the axis of the stylus 22. Incidentally, the displacement in the present arrangement is a kind of "static" displacement, which is different from vibration where the movement of the piezoelectric elements is minutely repeated.

[0015] The direction of the friction force at respective contact points between the cylindrical body 23 and the hard ball 13 aligns by the displacement, so that the reseat position can be adjusted to return the movable component by the biasing force.

[0016] However, in the above-described mechanism, though "axial shift", i.e. the reseat shift error in axial direction of the cylindrical body 23 can be effectively corrected, "circumferential error", i.e., the reseat shift error in a circumferential direction around the axis of the stylus 22 cannot be sufficiently corrected.

[0017] Specifically, as shown in Figs. 8(A) (seen from an upper direction in Fig. 7) and 8(B) (seen from an outside on the axis of the cylindrical body 23), when the movable component 21 conducts the return movement after the stylus 22 touches the workpiece, the cylindrical body 23 can be shifted in the circumferential direction around the axis of the stylus 22 to be supported by only one of the hard balls 13. When the cylindrical body 23 is displaced in the axis direction while being shifted in the circumferential direction, the cylindrical body 23 slides in the axial direction while keeping shift in the circumferential direction as shown in Figs. 8(C) to (H), so that the circumferential shift cannot be sufficiently eliminated.

[0018] The above phenomenon is thought to be caused because the effect of the biasing force for eliminating the circumferential direction is blocked by strain energy on a surface of the hard balls 13.

[0019] Specifically, minute elastic deformation is generated at the contact point P1 between the cylindrical body 23 as the reseat component on the movable component side and the hard ball 13 as the reseat component on the fixed component side on both the cylindrical body 23 side and the hard ball 13 side. Immediately after the stylus 22 is no more in contact with the workpiece and the movable component 21 conducts the return movement, there is dispersion in the direction of the elastic deformation at respective contact points P1a and P1b between the cylindrical body 23 as the reseat component on the movable component side and the hard ball 13 as the reseat component on the fixed component side and the force applied to the respective contact point. Though slightly, the elastically deformed portion receives relative slide of the movable component 21 and the fixed component 11, thus blocking return movement by the biasing force.

[0020] When displacement voltage is synchronously applied to the respective piezoelectric elements 14, the respective hard balls 13 move to project and retreat in a direction radial to the axis of the stylus 22 relative to the rest position thereof. Accordingly, the cylindrical body 23 temporarily slides in an axial direction relative to the hard ball 13. And the contact point on the cylindrical body 23 sequentially moves from P1a in Fig. 8(A) to P2 in Fig. 8(C), P3 in Fig. 8(E) and P4 in Fig. 8(G). Therefore, the direction of the elastic deformation at the contact points and the force applied to the contact point can be leveled on the cylindrical body 23 side, thus eliminating the axial shift.

[0021] However, as shown in Figs. 8(B), 8(D), 8(F) and 8(H), the contact point P1b on the hard ball 23 stays at one point irrespective of the slide of the cylindrical body 23, and the elastic deformation cannot be leveled. Accordingly, the strain energy for preventing the cylindrical body 23 from returning in the circumferential direction still works on the contact point P1b on the hard ball 23 side, which is thought to be a reason for the circumferential shift not to be eliminated. Since the circumferential shift still remains, reseat shift cannot be corrected with extremely high accuracy.

[0022] An object of the present invention is to provide a reseat system of a touch signal probe capable of highly accurately correcting reseat shift error after return movement of the movable component.

[0023] A reseat system of a touch signal probe according to the present invention includes: a fixed component; a movable component having a stylus; a first reseat component provided on the fixed component; a second reseat component provided on the movable component, the second reseat component touching the first reseat component at a pair of contact point on three locations mutually spaced apart, the reseat system of a touch signal probe allowing displacement of the movable component relative to the fixed component when outside force is applied to the stylus and returning the movable component to a rest position when the outside force is not applied to the stylus by virtue of a biasing force; and a contact point displacer for changing both of the contact point on the fixed component and the contact point on the movable component

for at least a predetermined distance.

[0024] According to the present invention, during return movement of the movable component, both of the contact point on the fixed component and the contact point on the movable component change position thereof. Accordingly, neither one of contact point on the fixed component or the contact point on the movable component keeps elastic deformation during displacement as contrary to the conventional arrangement, so that the strain energy by the elastic deformation is eliminated by the displacement. Therefore, a force for preventing return to the rest position does not work on any one of the contact points on the fixed component and the movable component, so that the reseat shift error can be effectively corrected.

[0025] In the above-described reseat system of a touch signal probe, the predetermined distance may preferably be larger than Hertzian elastic deformation caused on the contact points on the fixed component and the movable component.

[0026] Accordingly, since the movement amount of both of the contact points on the fixed component and the movable component exceeds the Hertzian elastic deformation, the strain energy can be sufficiently eliminated by the elastic deformation, so that shift correction function can be effectively performed.

[0027] In the above arrangement, the contact point displacer may preferably include: a curved surface formed on one of the first reseat component and the second reseat component; a slant surface formed on the other of the first reseat component and the second reseat component, the slant surface slanting relative to a radial direction of an axis of the stylus; and a drive source for relatively displacing the first reseat component and the second reseat component.

[0028] According to the present arrangement, both position of both of the contact points on the movable component and the fixed component can be changed by a single drive source. Therefore, the construction of the reseat system can be simplified.

[0029] Specifically, one of the first reseat component and the second reseat component may preferably be a pair of hard ball and the other may preferably be a cylindrical body having conic outer circumference.

[0030] Alternatively, one of the first reseat component and the second reseat component may preferably be a pair of cylindrical body arranged in V-shape and the other may preferably be a cylindrical body having conic outer circumference.

[0031] Further alternatively, one of the first reseat component and the second reseat component may preferably be one hard ball and the other may preferably be a V-shape groove having cut surface slanting relative to the radial direction of the axis of the stylus.

[0032] According to the above configuration, the effect of the present invention can be achieved only by changing a part of a component of the conventional reseat system. Therefore, conventional product facility, product parts and production process can be applied to the product of the present invention, thus avoiding significant increase in the production cost. Further, a component having high accuracy can be easily manufactured, thereby easily implementing the effect of the present invention.

[0033] In the above, the contact point displacer may preferably include a displacement generator for relatively displacing the first reseat component and the second reseat component on respective contact points between the first reseat component and the second reseat component while keeping contact between the movable component and the fixed component after the outside force is ceased to be applied to the movable component to finally return the movable component to the rest position, the displacement generator also serving as the drive source.

[0034] In the present invention, the circumferential shift can be corrected during return movement even without the displacement generator by changing positions of both of the contact points on the fixed component and the movable component during, for instance, minute slide movement in returning the movable component to the rest position. In this case, the drive source is a mechanism for returning the movable component to an initial posture.

[0035] Further, at least one of the first reseat component and the second reseat component may be rotated to change the positions of the contact points on both of the fixed component and the movable component without relatively displacing the fixed component and the movable component. In this case, the rotary mechanism serves as the drive source.

[0036] However, by providing the displacement generator for artificially causing relative displacement of the fixed component and the movable component after return movement thereof, the circumferential shift can be corrected with high accuracy by a simple structure.

[0037] In the above, it is preferable that the displacement generator relatively displaces the respective fixed components and the respective movable components along only a single direction.

[0038] Though the above-described present invention can be implemented by providing piezoelectric elements for displacing in a plurality of different directions, the structure can be complicated. According to the above arrangement, the effect of the present invention can be achieved by providing only one displacement generator for each combination of the fixed component and movable component. Accordingly, the structure of the reseat system can be simplified without largely increasing production cost thereof.

Fig. 1 is a perspective view showing a reseat system of a touch signal probe according first embodiment of the present invention;

Figs. 2(A) to (H) are illustrations for showing an effect of the first embodiment, where (A), (C), (E)

and (G) are illustrations of relative displacement between cylindrical body 44 and hard ball 34 seen from a movable component side, and where (B), (D), (F) and (H) are end views showing cross sections perpendicular to displacement direction, the cross section including the cylindrical body 44, the hard ball 34 and contact point thereof;

Fig. 3 is a perspective view showing a reseat system of a touch signal probe according to second embodiment of the present invention;

Fig. 4 is a perspective view showing a reseat system of a touch signal probe according to third embodiment of the present invention;

Fig. 5 is a perspective view showing a reseat system of a conventional reseat system of a touch signal probe;

Fig. 6 is an illustration of problem associated with the conventional reseat system of a touch signal probe;

Fig. 7 is a perspective view showing a conventional reseat system having a displacement generator; and

Figs. 8 (A) to (H) are illustrations of problem associated with the conventional reseat system having the displacement generator, where (A), (C), (E) and (G) are illustrations of relative displacement between cylindrical body 23 and hard ball 13 seen from a movable component side, and where (B), (D), (F) and (H) are end views showing cross sections perpendicular to displacement direction, the cross section including the cylindrical body 23, the hard ball 13 and contact point thereof.

[0039] An embodiment of the present invention will be described below with reference to attached drawings. Incidentally, in the respective embodiments, the same reference numeral will be attached to the same component to omit or simplify description thereof.

[First Embodiment]

[0040] Fig. 1 shows first embodiment of the present invention. The touch signal probe 10 of the first embodiment includes a fixed component 31, a movable component 41 having a stylus 42, and a reseat system 10A between the fixed component 31 and the movable component 41.

[0041] The fixed component 31 includes a base portion having a though hole 35 for the stylus 42 to be inserted, and three support arms 32 extending from the base portion at 120 degrees interval radially from the stylus axis. A pair of hard ball 34 is provided on the respective support arms 32 adjacent to distal end thereof and, further, a piezoelectric element 33 for stretching and contracting the support arm by applying electric voltage between the hard balls 34 and the base portion is provided on the support arms 32.

[0042] In the above, the hard ball 34 constitutes a reseat component on fixed component side and the piezoelectric element 33 constitutes a displacement generator of the present invention.

[0043] A contact ball 43 to be in contact with the workpiece is provided on a pointed end of the stylus 42. Further, the movable component 41 has three cylindrical bodies 44 extending radially from an axis of the stylus 42 at 120 degrees interval and having outer circumference with narrower pointed end than base end thereof on a position corresponding to a center of the pair of hard ball 34. The cylindrical body 44 constitutes a reseat component on movable component side of the present invention.

[0044] In the above arrangement, when the contact ball 43 comes out of contact with the workpiece and the movable component 41 conducts return movement, the movable component 41 restores contact with the fixed component by virtue of biasing force. At this time, in accordance with the contact and return movement, respective cylindrical bodies 44 slide in a direction approximately opposite to the contact point with the workpiece relative to the respective hard balls 34 to be shifted.

[0045] However, since the respective cylindrical bodies 44 has a tapered surface, the contact points on both of the cylindrical body 44 and the hard ball 34 respectively moves position thereof. Accordingly, the return effect on account of the biasing force is less likely to be hindered by the elastic deformation at the respective contact points, thus preventing the circumferential shift with high accuracy.

[0046] After the above return movement, a displacement voltage is applied to the respective piezoelectric elements 33 to synchronously conduct displacement movement.

[0047] When the displacement voltage is applied, the respective piezoelectric elements displace in an approximately radial direction relative to the axis of the stylus 42. The displacement at this time exceeds Hertzian elastic deformation. Incidentally, the "displacement" herein refers to a static displacement, which is different from "vibration" where minute movement by the piezoelectric element is repeated.

[0048] In accordance with the displacement, the hard balls 34 also displace respectively in displacement direction of the piezoelectric element, thus conducting relative slide movement between corresponding cylindrical bodies 44.

[0049] The respective hard ball 34 and the cylindrical body 44 relatively displace by the slide movement as shown in Fig. 2.

[0050] Specifically, as shown in Fig. 2(A), circumferential shift is caused immediately before the displacement voltage is applied to the respective piezoelectric elements 33 and the cylindrical body 44 is supported only by one of the pair of hard ball 34 (right side in the figure). At this time, as shown in Fig. 2(B), the cylindrical body 44 and the one of the hard balls 34 is in contact

with each other at contact point P1.

[0051] When the displacement voltage is applied to the respective piezoelectric elements 33 and the piezoelectric elements 33 are deformed to stretch from the base portion of the fixed component 31 to the hard ball 34, the cylindrical body 44 retreats relative to the hard ball 34 in radial direction from the axis of the stylus. At this time, the contact point on the cylindrical body 44 side moves from P1 to P2 in the figure by the relative retraction of the cylindrical body 44. Further, as shown in Fig. 2(D), the contact point P1 on the hard ball 34 side also moves to P3. This is because the tapered surface of the cylindrical body 44 slides in the circumferential direction (D direction in the figure) by virtue of the biasing force applied to the movable component 41. Incidentally, the other hard ball 34 (left in the figure) and the cylindrical body 44 may not be in contact with each other according to magnitude of initial circumferential shift.

[0052] Subsequently, when the respective piezoelectric elements 33 deforms to contract from the hard ball 34 side toward the base portion of the fixed component 31, the cylindrical body 44 projects in radial direction of the axis of the stylus relative to the hard ball 34. At this time, the tapered surface of the cylindrical body 44 further slides in D direction by the biasing force applied to the movable component 41, so that both the cylindrical body 44 and the pair of hard ball 34 touch with each other. And the contact point on the cylindrical body 44 side moves from P2 to P4 in the figure by the relative retraction of the cylindrical body 44. Further, as shown in Fig. 2(F), the contact point P3 on the hard ball 34 side also moves to P5.

[0053] Subsequently, when the displacement voltage is no more applied and the cylindrical body 44 and the hard ball 34 are stilled, the cylindrical body 44 and the hard ball 34 are kept being in contact with each other at two points as shown in Fig. 2(G) and 2(H).

[0054] According to the present embodiment, the contact point on both of the cylindrical body 44 and the hard ball 34 respectively changes position thereof in accordance with relative slide movement of the cylindrical body 44 and the hard ball 34 by the piezoelectric element 33. Accordingly, the elastic deformation on the contact point of the cylindrical body 44 with the hard ball 34 does not restrict the cylindrical body 44 from sliding in circumferential direction as well as in axial direction. Therefore, the reseat shift error can be corrected by displacement movement by the piezoelectric element 33 with high accuracy.

[0055] Further, since the cylindrical body 44 has a tapered surface having narrower end than the base thereof, the cylindrical body 44 moves to correct the circumferential shift by the function of the biasing force during relative slide movement by the piezoelectric element 33. Accordingly, further accurate correction of the reseat shift error is possible by employing piezoelectric element 33 capable of displacing in only one direction. Further, since the same arrangement as the conventional products can be used except for the cylindrical body 44, the manufacture process and facility can be also used for manufacturing the present product, thus not increasing the production cost.

[Second Embodiment]

[0056] Fig. 3 shows second embodiment of the present invention. The present invention differs from the above-described first embodiment in that a reversely tapered cylindrical body 45 with so-called reverse tapered surface having wider distal end than the base end is used as the reseat component on the movable component side instead of the cylindrical body 44 of the first embodiment.

[0057] In the present embodiment, the contact point on both the reverse cylindrical body 45 and the hard ball 34 also moves while changing position thereof on respective components on account of outer circumferential tapered surface of the reverse tapered cylindrical body 45 as the reseat component on movable component side.

[0058] Accordingly, the same effect as mentioned in the first embodiment can be attained.

[Third Embodiment]

[0059] Fig. 4 shows third embodiment of the present invention. In the present embodiment, a single hard ball 47 provided on a surface of the movable component facing the fixed component is used as the reseat component on the movable component side.

[0060] And a V-shape groove 36 provided on a projection projecting from a distal end of the support arm 32 and having an cut surface slanting relative to displacement direction by the piezoelectric element 33 is used as the reseat component on the fixed component side.

[0061] In the present embodiment, since the cut surface of the V-shape groove 36 is slanted in radial direction of the axis of the stylus 42, the contact points on the hard ball 47 side and the V-shape groove 36 side respectively change the position thereof.

[0062] Accordingly, the force for preventing correction of the reseat shift error of the movable component is not generated by the elastic deformation on respective contact points, so that the reseat shift error can be corrected with high accuracy.

[0063] Further, since the V-shape groove 36 has the cut surface slanting relative to the displacement direction by the piezoelectric element 33, the hard ball 47 moves to correct the circumferential shift by the effect of the biasing force during the relative slide movement by the piezoelectric element 33. Accordingly, further accurate correction of the reseat shift error is possible by employing the piezoelectric element 33 displacing along only one direction.

[Modifications]

[0064] Incidentally, the scope of the present invention is not restricted to the aforesaid embodiments, but includes following modifications as long as an object of the present invention can be attained.

[0065] Configuration of the movable component according to the present invention is not limited to the configuration mentioned in the aforesaid embodiments, but may be a disk having diameter identical with or larger than length of the support arm of the fixed component 31 or may be polygon such as a triangle. Further, the configuration of the fixed component 31 is not restricted to the above arrangement of small base portion having the support arm, but may be polygon such as a triangle having through hole at the center thereof. In short, any configuration is possible for the fixed component and the movable component as long as the reseat component on the movable component side can be supported to correspond to the reseat component on the fixed component side.

[0066] Though a pair of hard ball is used for the reseat component on the fixed component side in the aforesaid first and the second embodiment, a pair of cylinders arranged in V-shape may be used instead thereof. Though the hard ball 47 is used as the reseat component on movable component side and the V-shape groove 36 is used as the reseat component on fixed component side in the third embodiment, the combination of the reseat component on movable component side and reseat component on fixed component side may be a pair of hard ball and a projection having cross section such as V-shape. Alternatively, the combination of the reseat component on movable component side and reseat component on fixed component side may be one hard ball and a wedge-shape groove having bottom base line slanting toward biasing force direction as getting farther from the axis of the stylus.

[0067] In short, the scope of the present invention includes all of the arrangement where both of the position of the contact point on the fixed component side and the position of the contact point on the movable component side respectively changes during relative displacement of the fixed component and the movable component.

[0068] In the above-described embodiments, a displacement generator using a piezoelectric element for displacing in an approximately radial direction relative to the axis of the stylus is used as the drive source. However, the drive source of the present invention is not restricted to the displacement generator. For instance, the slide movement mechanism during return movement of the movable component after being in contact with the workpiece may be used as the drive source, or alternatively, a rotating mechanism for rotating the reseat component on movable component side and reseat component on fixed component side without displacement may be used.

[0069] Further, when the displacement generator is used in the present invention, the displacement generator is not restricted to the piezoelectric element. For instance, an excitation coil may be used, or alternatively, other drive means such as electrostatic, air-pressure and hydraulic pressure mechanism may be used.

[0070] Further, the displacement direction is not restricted to the approximate radial direction relative to the axis of the stylus, but may be a direction perpendicular to the parallel line of the stylus axis. For instance, the displacement generator may be disposed between the pair of hard ball in the first embodiment. Further, though one displacement generator is used for each combination of the reseat component on movable component side and reseat component on fixed component side, a plurality of displacement generator may be used for each combination. Further, though the displacement generator is provided to the fixed component side, the displacement generator may be provided to the movable component side.

[0071] In other words, any arrangement is possible for the displacement generator as long as relative displacement can be caused between the reseat component on movable component side and reseat component on fixed component side.

Claims

1. A reseat system (10) of a touch signal probe, comprising:

   a fixed component (31);
   a movable component (41) having a stylus (42);
   a first reseat component provided on the fixed component; and
   a second reseat component provided on the movable component, the second reseat component touching the first reseat component at a pair of contact point on three locations mutually spaced apart,
   the reseat system of a touch signal probe allowing displacement of the movable component relative to the fixed component when outside force is applied to the stylus and returning the movable component to a rest position when the outside force is not applied to the stylus by virtue of a biasing force, the reseat system being characterized by having a contact point displacer for changing both of the contact point on the fixed component and the contact point on the movable component for at least a predetermined distance.

2. The reseat system of a touch signal probe according to Claim 1, wherein the predetermined distance is larger than Hertzian elastic deformation caused on the contact points on the fixed component and

the movable component.

3. The reseat system of a touch signal probe according to Claim 1 or 2, the contact point displacer comprising:

    a curved surface formed on one of the first reseat component and the second reseat component;
    a slant surface formed on the other of the first reseat component and the second reseat component, the slant surface slanting relative to a radial direction of an axis of the stylus; and
    a drive source for relatively displacing the first reseat component and the second reseat component.

4. A reseat system according to any of claims 1 to 3, wherein one of the first reseat component and the second reseat component is a pair of hard ball (34) and the other is a cylindrical body (44, 45) having conic outer circumference.

5. A system according to any of the preceding claims, wherein one of the first reseat component and the second reseat component is a pair of cylindrical body arranged in V-shape and the other is a cylindrical body having conic outer circumference.

6. A system according to any of claims 1 to 4, wherein one of the first reseat component and the second reseat component is one hard ball (47) and the other is a V-shape groove (36) having cut surface slanting relative to the radial direction of the axis of the stylus.

7. A reseat system according to any one of Claims 1 to 6, wherein the contact point displacer includes a displacement generator (33) for relatively displacing the first reseat component and the second reseat component on respective contact points between the first reseat component and the second reseat component while keeping contact between the movable component and the fixed component after the outside force is ceased to be applied to the movable component to finally return the movable component to the rest position, the displacement generator also serving as the drive source.

8. The reseat system of a touch signal probe according to Claim 7,
wherein the displacement generator relatively displaces the respective fixed components and the respective movable components along only a single direction.

FIG. 1

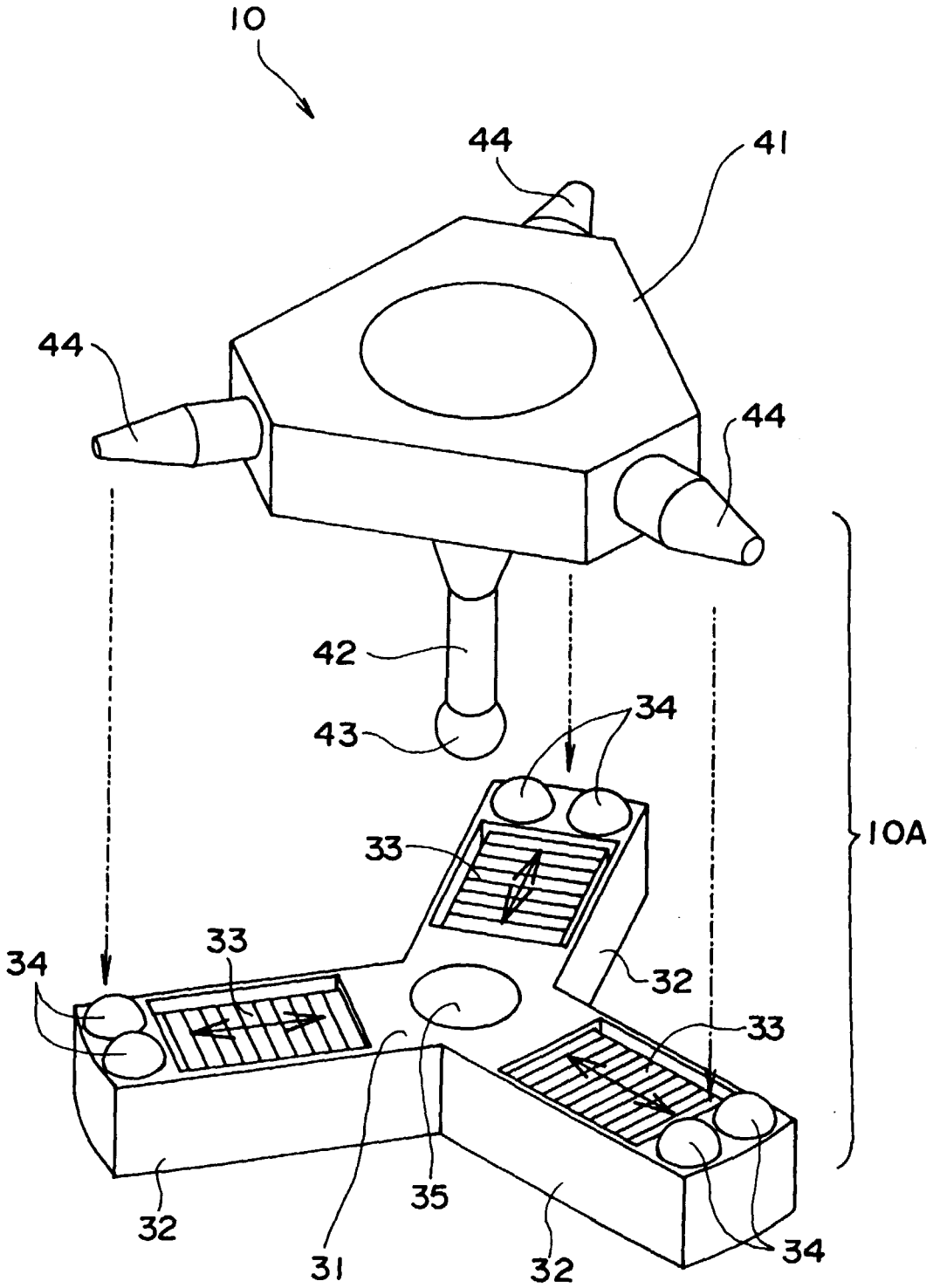


FIG.2A

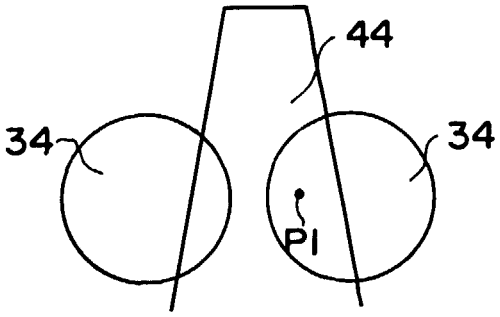


FIG.2B

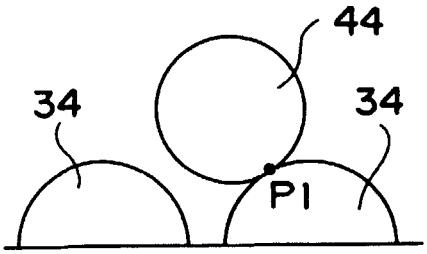


FIG.2C

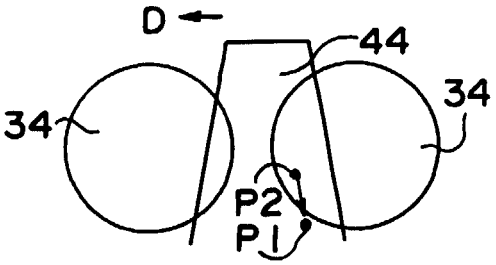


FIG.2D

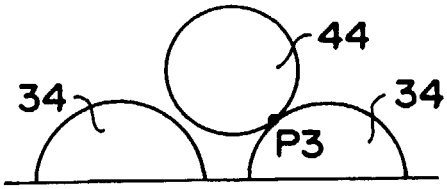


FIG.2E

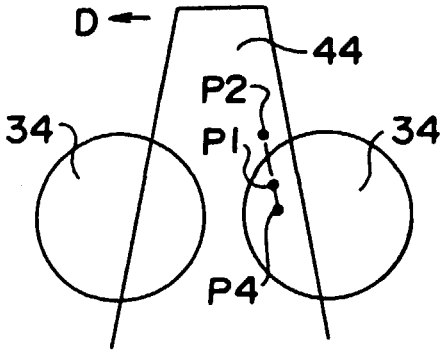


FIG.2F

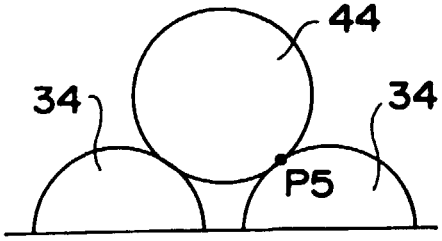


FIG.2G

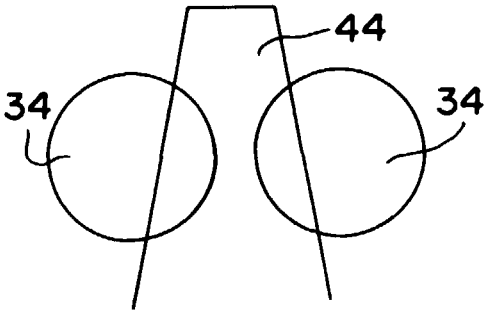


FIG.2H

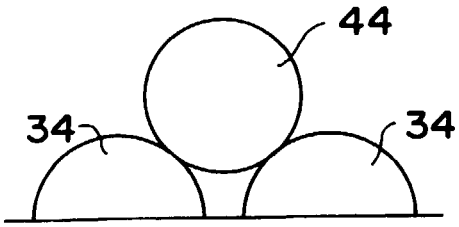


FIG. 3

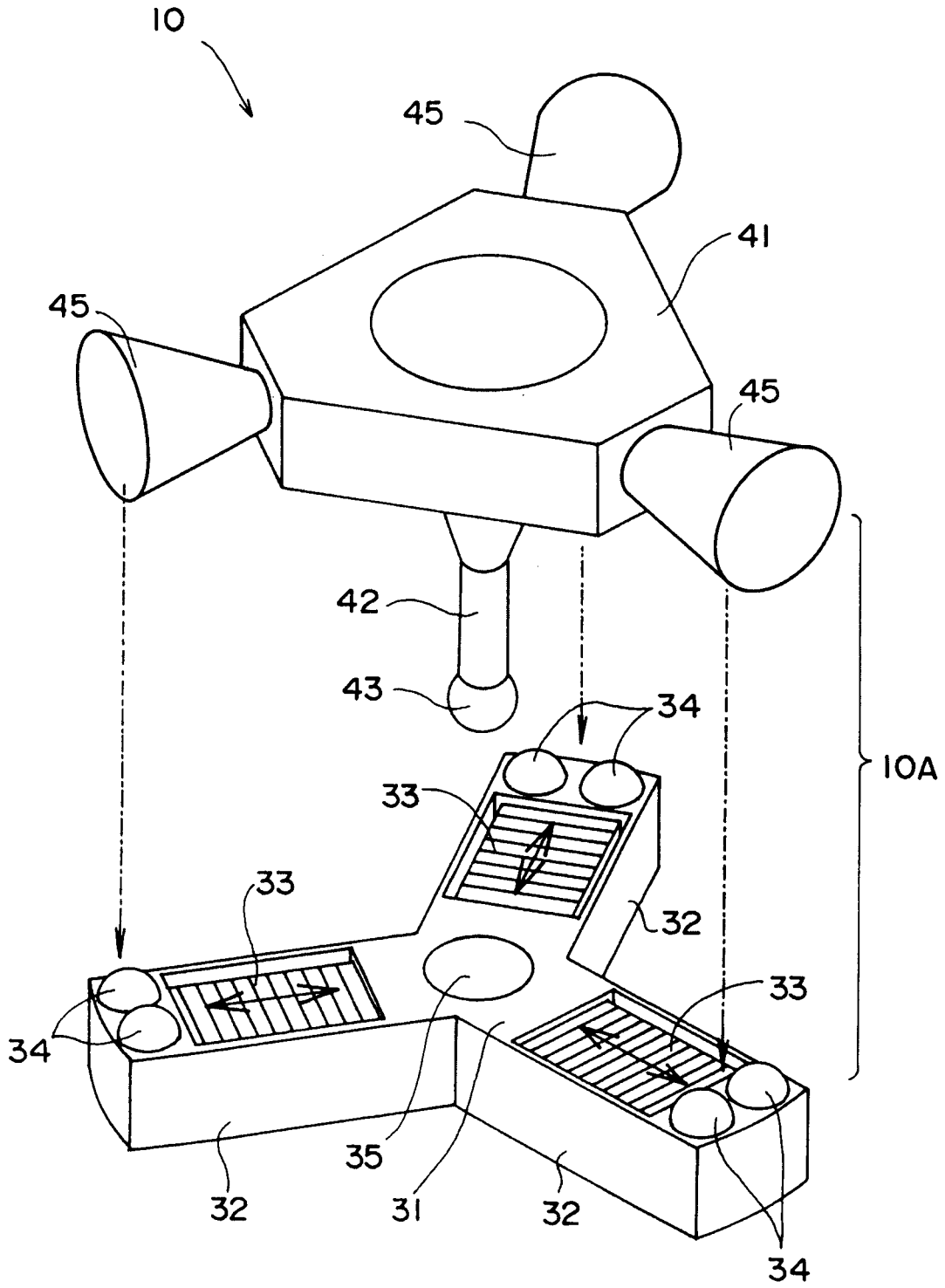


FIG. 4

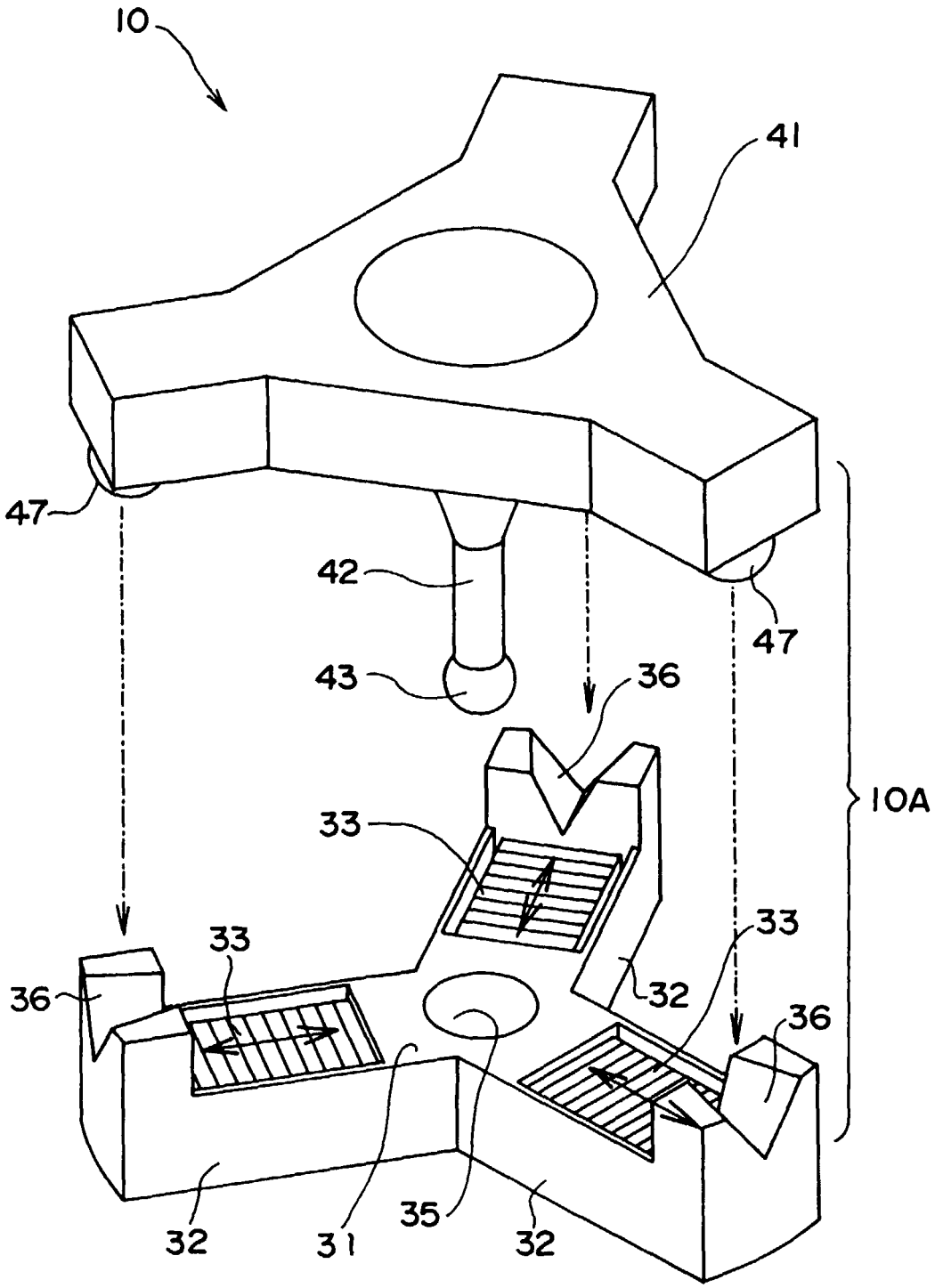


FIG. 5
PRIOR ART

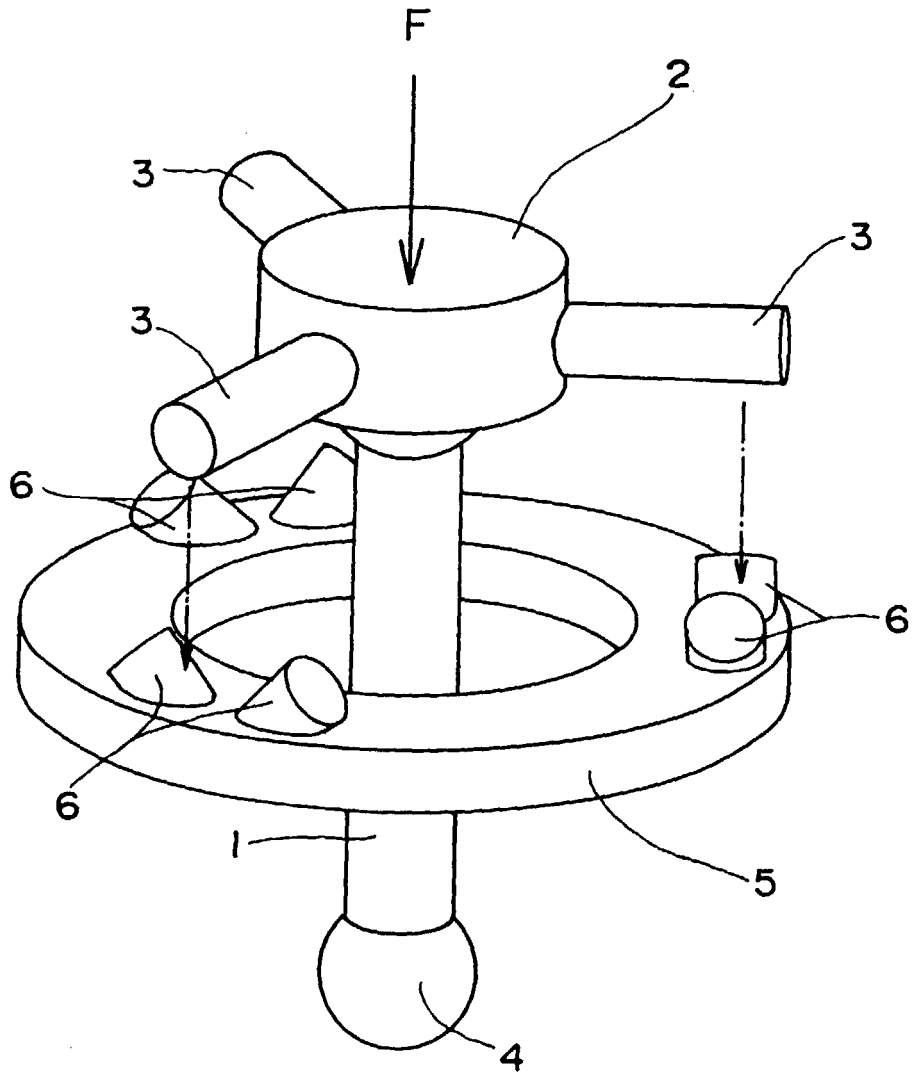


FIG. 6A
PRIOR ART

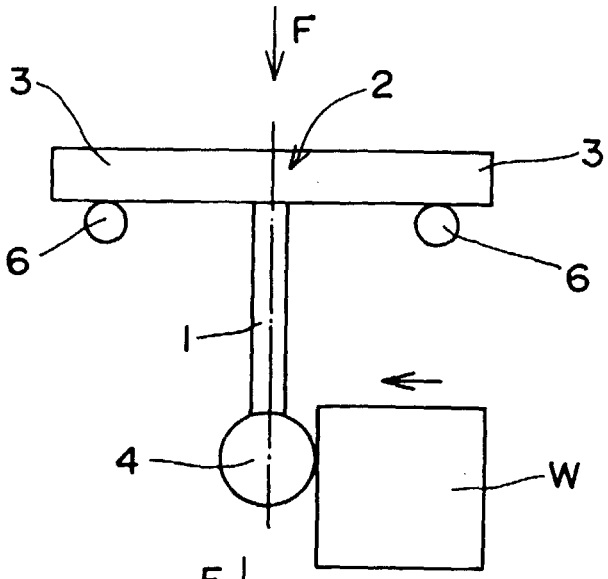


FIG. 6B
PRIOR ART

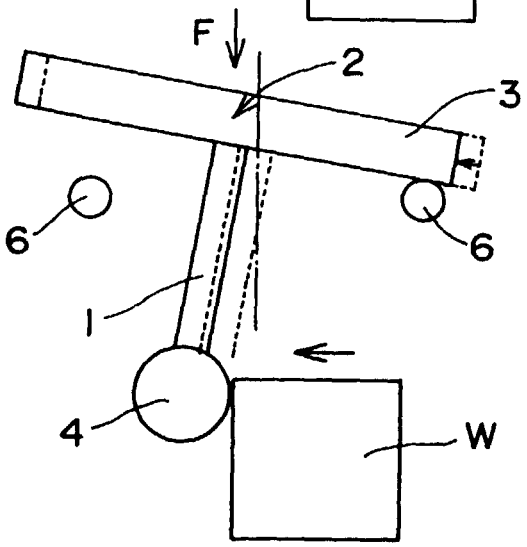


FIG. 6C
PRIOR ART

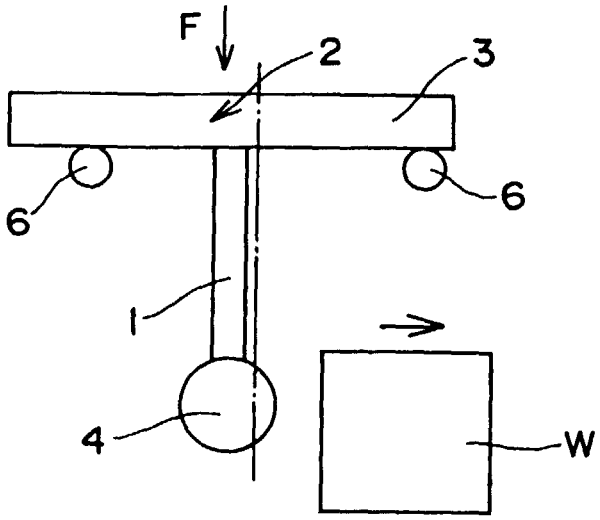


FIG. 7
PRIOR ART

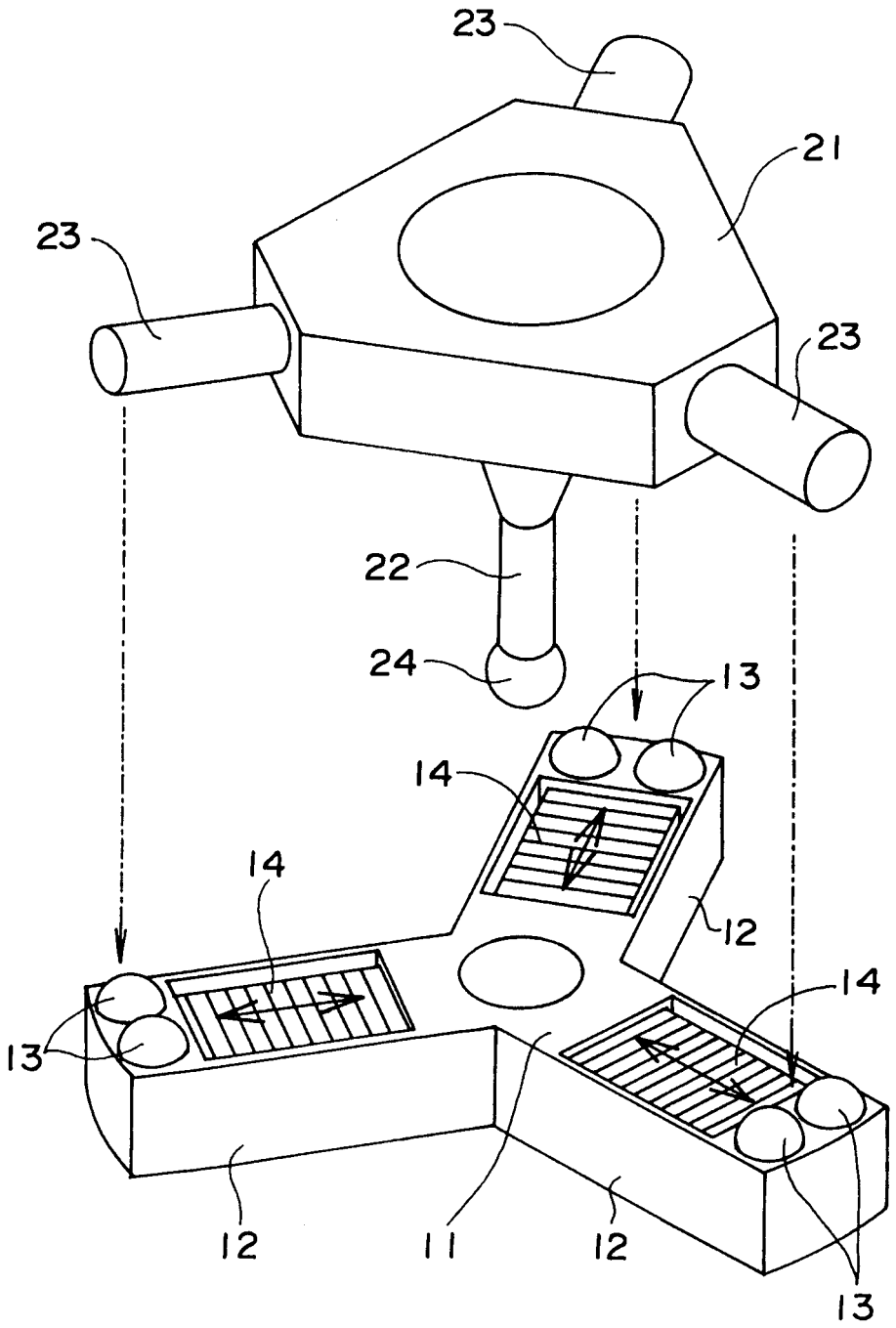


FIG. 8A
PRIOR ART

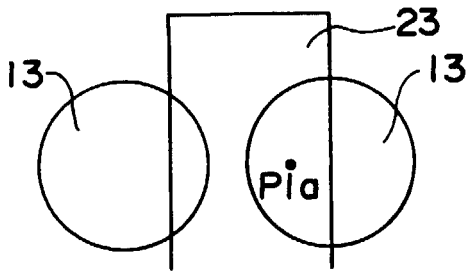


FIG. 8B
PRIOR ART

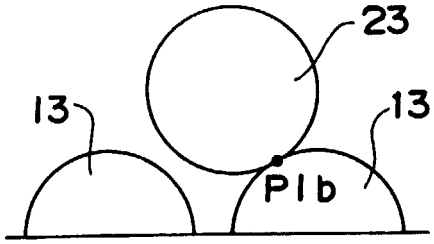


FIG. 8C
PRIOR ART

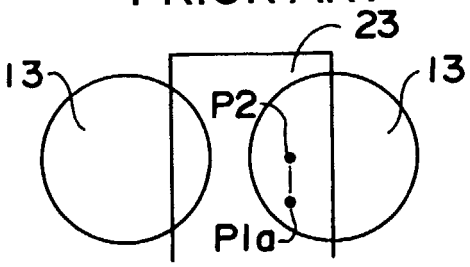


FIG. 8D
PRIOR ART

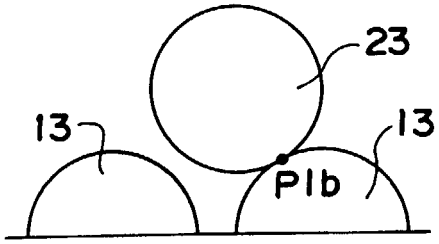


FIG. 8E
PRIOR ART

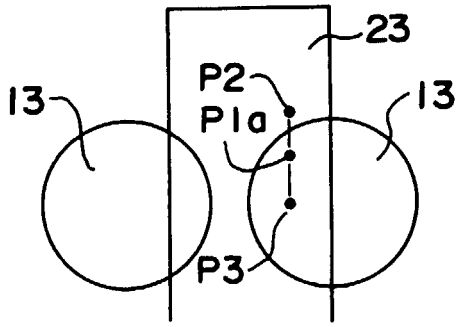


FIG. 8F
PRIOR ART

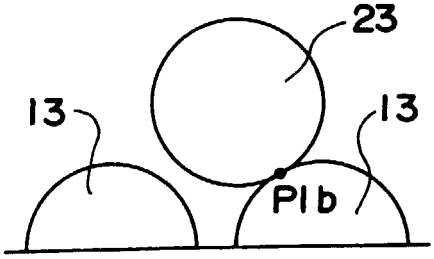


FIG. 8G
PRIOR ART

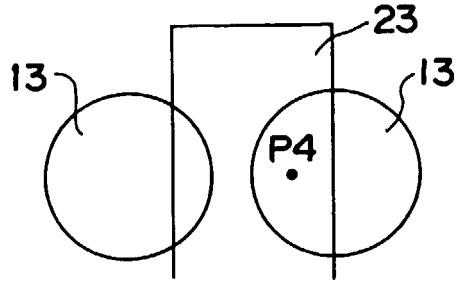
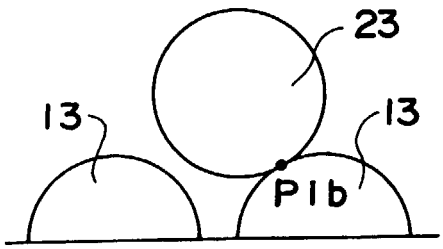


FIG. 8H
PRIOR ART



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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 5041

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,X	EP 0 764 827 A (MITUTOYO) 26 March 1997 (1997-03-26) * figures 5,8,9,18 *	1	G01B5/012 G01B7/012
X	US 4 859 817 A (TESA) 22 August 1989 (1989-08-22) * figures 3,4 *	1-8	
X	EP 0 654 651 A (RENISHAW) 24 May 1995 (1995-05-24) * figure 9 *	1-8	
A	US 5 018 280 A (ZEISS) 28 May 1991 (1991-05-28) * column 2, line 35 - line 42 *		
A	WO 95 22739 A (RENISHAW) 24 August 1995 (1995-08-24) * figures 1,3 *		
A	US 5 299 361 A (HEIDENHAIN) 5 April 1994 (1994-04-05) * figures 1-3 *		TECHNICAL FIELDS SEARCHED (Int.Cl.7) G01B
A	DE 37 13 415 A (MAUSER) 3 November 1988 (1988-11-03) * figure 9 *		
A	US 4 138 823 A (ROLLS-ROYCE) 13 February 1979 (1979-02-13) * figures 1,2 *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	7 September 2000	Mielke, W

CATEGORY OF CITED DOCUMENTS

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07-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 764827 A	26-03-1997	JP 10096618 A	14-04-1998
		US 5756886 A	26-05-1998
US 4859817 A	22-08-1989	CH 672370 A	15-11-1989
		DE 3863038 D	04-07-1991
		DE 307782 T	13-07-1989
		EP 0307782 A	22-03-1989
		JP 1112624 A	01-05-1989
		JP 1866911 C	26-08-1994
		JP 5080771 B	10-11-1993
EP 654651 A	24-05-1995	DE 69102283 D	07-07-1994
		DE 69103930 D	20-10-1994
		DE 69104215 D	27-10-1994
		DE 69105862 D	26-01-1995
		DE 69111830 D	07-09-1995
		DE 551164 T	25-11-1993
		DE 551165 T	25-11-1993
		DE 598709 T	17-11-1994
		EP 0445945 A	11-09-1991
		EP 0470234 A	12-02-1992
		EP 0551164 A	14-07-1993
		EP 0551165 A	14-07-1993
		EP 0598709 A	25-05-1994
		WO 9113316 A	05-09-1991
		JP 4339205 A	26-11-1992
		JP 3004050 B	31-01-2000
		JP 4506706 T	19-11-1992
		US 5323540 A	28-06-1994
		US 5353514 A	11-10-1994
		US 5505005 A	09-04-1996
		US 5491904 A	20-02-1996
		US 5669152 A	23-09-1997
		US 5146691 A	15-09-1992
		US 5339535 A	23-08-1994
		US 5345690 A	13-09-1994
		US 5253428 A	19-10-1993
US 5018280 A	28-05-1991	DE 3824548 A	25-01-1990
		DE 58901626 D	16-07-1992
		EP 0351713 A	24-01-1990
		ES 2033492 T	16-03-1993
		JP 2069613 A	08-03-1990
		JP 2845959 B	13-01-1999
WO 9522739 A	24-08-1995	EP 0695412 A	07-02-1996

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07-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9522739 A		JP 8509299 T	01-10-1996
		US 5634280 A	03-06-1997
US 5299361 A	05-04-1994	EP 0524341 A	27-01-1993
		AT 111590 T	15-09-1994
		DE 4132166 A	28-01-1993
		DE 59102956 D	20-10-1994
		JP 2534425 B	18-09-1996
		JP 5248848 A	28-09-1993
DE 3713415 A	03-11-1988	NONE	
US 4138823 A	13-02-1979	GB 1593682 A	22-07-1981
		CH 617617 A	13-06-1980
		DE 2801656 A	19-10-1978
		FR 2378259 A	18-08-1978
		JP 1192776 C	29-02-1984
		JP 53112772 A	02-10-1978
		JP 58025202 B	26-05-1983
		SE 422996 B	05-04-1982
		SE 7800602 A	21-07-1978

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